

# Bridges

By Graham Rickard



## The First Bridges

Crossing natural obstacles, such as rivers and deep valleys, has always been a challenge to people. Our first real bridges were probably trees, which had fallen across streams. These natural bridges may well have given us the idea of making simple wooden beam bridges. Then, when a stream was too wide to be spanned by a single log or plank, these early bridge builders used two or more beams to reach the other side. The planks were supported by wooden logs, called piers, standing upright in the water.

In areas where trees were scarce, similar bridges were built from large slabs of stone. The world's oldest surviving bridges of this kind can still be seen on Dartmoor in England. They are called clam or clapper bridges.

In China, India and South America, people developed the art of building hanging bridges from ropes to creepers. These materials do not last very long, but these early bridges were the forerunners of our modern suspension bridges.

Throughout the ages, new transportation systems developed, such as railroads, canals and main roads. Each new system needed a whole new generation of bridges, using new techniques, styles and materials to build them even longer and stronger than before.

## Roman Bridges

Besides being great fighters, the soldiers of the Roman Army were great engineers. They became very skilled at bridge-building, and when Julius Caesar invaded Gaul, his army built a bridge across the Rhine River in only ten days.

When the Romans invaded parts of Asia, they discovered the secret of building a stone arch. The arch is a very strong shape and its strength led to a great change in bridge-building techniques. It enabled the Romans to build much longer bridges, with fewer piers between each span. Because these new arched bridges were built of stone or brick, they lasted much longer than the older wooden bridges, and many fine examples can still be seen today. In Rome itself, six fine stone bridges remain out of the eight that the Romans built over the Tiber River.

One of the things that helped these bridges to last so long was the Romans' discovery of cement concrete. They used a mixture of volcanic soil, lime and water that would set hard even under water and enabled their engineers to build very strong piers for their bridges. In the nineteenth century it was discovered that concrete could be made

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**LA.A.2.2.7 Compare/Contrast & LA.E.1.2.3 Sim/Diff Form B**

strong enough to build entire bridges by reinforcing it with iron bars. Today reinforced concrete is one of the main materials used to build bridges.

### **Modern Bridges**

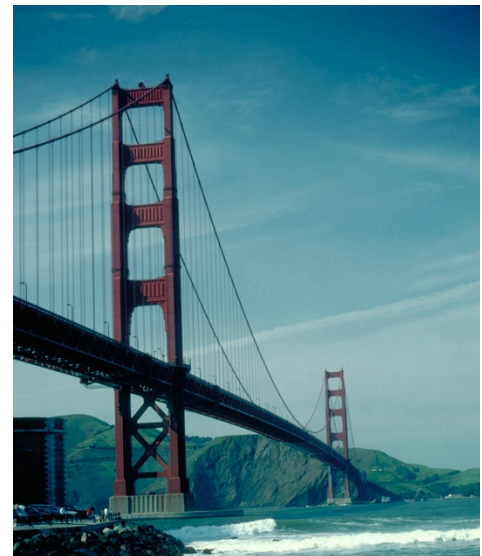
The great increase in road traffic during the twentieth century has forced almost every country to modernize and improve its road systems, creating thousands of miles of highways. This has involved the building of many new types of road bridges, using the very latest materials.

The world's longest spans are all suspension bridges, which rely totally on the strength of steel. They vary in design, but all suspension bridges, from the most primitive rope crossings to the very latest steel structures, have three basic elements—cables, towers and anchorages. The cables support the weight of the deck and the traffic that passes over the bridge. The towers, made of wood, stone, or steel, hold up the cables, which pass over the top of them. The anchorages fasten the cables to the ground, and their weight and strength are very important to the safety of the bridge.

Suspension highways sway in the wind. This caused a disaster in the United States in 1940, when the new Tacoma Narrows Bridge started to twist in a gale. It finally broke up, ripping loose from its cables and crashing into the waters below. But the knowledge gained from this disaster led to new safer designs for future bridges. Today, the longest suspension bridge is the Humber Estuary Bridge in England. It spans 1,410 m (4,626 ft). In the future, longer bridges will certainly be built.

Not all modern bridges are of the suspension type. They can be of arch, beam, or cantilever designs, depending on the length of the span and the purpose of the bridge. Reinforced concrete is often used on major highways to make beam bridges and overpasses, and Waterloo Bridge in London is an example of a graceful concrete arch. The largest concrete arch of all spans 304.8 m (1,000 ft) of water. This is the Gladesville Bridge in Sydney, Australia. Nearby is the famous arch of the Sydney Harbour Bridge, which is made of steel. The deck of this bridge hangs by thick steel rods from a massive steel arch. The Thousand Island Bridge, linking Canada and the United States across the St. Lawrence River, is a mixture of three types of bridges. It uses suspension, a steel arch and strengthened beams.

New materials will probably be used in the near future to make bridges longer, stronger and lighter than was ever thought possible in the past. Massive bridges linking, for example, Italy with the island of Sicily will become possible for the first time. What is certain is that bridges will continue to evolve, and that engineers will make the best of new materials and techniques.



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Name \_\_\_\_\_ Date \_\_\_\_\_

Directions: Read the passage “Bridges”, then circle the letter of the correct answer.

1. How did the Romans change bridge building techniques?
  - A. They learned to build bridges quickly.
  - B. They became very skilled at bridge building.
  - C. They discovered ways to make bridges last longer.
  - D. They built eight stone bridges over the Tiber River.
  
2. According to the article, what is one way that Roman bridges and modern bridges are ALIKE?
  - A. Both are built for railroads.
  - B. Both are made of concrete.
  - C. Both are made of wooden planks.
  - D. Both are built by Roman engineers.
  
3. In the future, what will remain the SAME about bridge designs?
  - A. Bridge designs will continue to evolve.
  - B. Bridges designs will become more simple.
  - C. Bridge designs will rely on the strength of steel.
  - D. Bridges designs will depend on Roman engineers.
  
4. How is the suspension bridge DIFFERENT from most other modern bridges?
  - A. Suspension bridges have arches.
  - B. Suspension bridges have beams.
  - C. Suspension bridges cause disasters
  - D. Suspension bridges sway in the wind.
  
5. In what way did the designs of suspension bridges change after the disaster of 1940?
  - A. The designs became safer.
  - B. The designs became simpler.
  - C. The bridges held more weight.
  - D. The bridges have longer spans.

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**Answer Key – Bridges**

LA.A.2.2.7: The student identifies similar or dissimilar elements within or across texts or identifies how elements are alike or different within or across texts.

LA.E.1.2.3: The student identifies an explanation or analysis of similarities or differences among characters, within one character over time, between settings, or between events in one or more texts.

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